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PNNL-36407

High Velocity Joining of Multi-material Stacks Containing 3rd Generation Advanced High-Strength Stainless Steel and Aluminum Extrusion and Casting (Abstract)

CRADA #628 (PNNL #82765)

July 2024

Vineet V Joshi

Magna Services of America Inc.

U.S. DEPARTMENT OF ENERGY

Prepared for the U.S. Department of Energy
under Contract DE-AC05-76RL01830

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Pacific Northwest National Laboratory
Richland, Washington 99354

Abstract

Advanced lightweight materials, including multi-phase steels, aluminum extrusions and aluminum castings, have increasingly replaced mild steel to meet original equipment manufacturer (OEM) demand for increased fuel economy and crash-safety requirements. Third Generation (Gen 3) AHSS provides a superior combination of strength and ductility for crash energy management components in the vehicle body-in-white (BIW). Aluminum extrusions are widely used for bumper, door rocker panel, cradle and battery frame applications. Aluminum castings are increasingly being used in electric vehicles to provide part consolidation, weight saving and increased driving range. Rocker panels are, for example, an important component of the battery electric vehicle (BEV) body structure. The rocker panel serves several purposes, including structural support, crash resistance, protection for the vehicle's underbody and battery tray, and contributing to the overall aesthetics. In order to reduce weight, rocker panels are usually constructed using outer panels consisting of 3rd generation advanced high strength steels (AHSS) and an inner multicell aluminum extrusion structure for energy absorption which protects the batteries in a crash event. It is well known, however, that these material combinations provide significant challenges for joining and are susceptible to liquid metal embrittlement and loss of strength. The overall goal is to find a solution that addresses these challenges in order to produce multi-material vehicle components with reduced weight and minimal galvanic and recyclability issues. The approach being proposed here is to utilize a novel high velocity (HiVe) riveting and clinching technique recently demonstrated by Pacific Northwest National Laboratory (PNNL) to join (2T/3T) sheets of aluminum alloys and steel. This process will not only address the aforementioned challenges but also help significantly reduce the joining cycle time. This work will also demonstrate use of HiVe assemblies to be retrofitted to existing body-shop robots thus having minimal impact to existing body shop operations.

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